

# CLAIMS

What is claimed is:

- 1     1.     A switching node apparatus for use in an optical burst-switched network, comprising:  
2             optical switch fabric, having at least one input fiber port and at least one output fiber  
3     port; and  
4             a control unit, operatively coupled to control the optical switch fabric, including at  
5     least one processor and a storage device operatively coupled to said at least one processor  
6     containing machine-executable instructions, which when executed by said at least one  
7     processor perform operations, including:  
8             receiving a resource reservation request to reserve a bandwidth resource  
9             provided by the switching node apparatus, said resource reservation relating to a  
10            portion of a lightpath comprising a plurality of lightpath segments coupled between  
11            network nodes, including incoming and outgoing lightpath segments coupled to an  
12            input and an output port of the switching node apparatus, respectively;  
13            reserving the bandwidth resource;  
14            detecting an unavailability of the bandwidth resource;  
15            generating a resource cancellation message; and  
16            sending the resource cancellation message to at least one network node along  
17     the lightpath.

1     2.     The apparatus of claim 1 wherein execution of the instructions further performs the  
2     operations of:

3             canceling a resource reservation in response to receiving a resource cancellation  
4     message.

1     3.     The apparatus of claim1, where the optical burst-switched network is a mesh-  
2     architecture optical network.

1     4.     The apparatus of claim 1, further comprising at least one input port to link in  
2     communication with one or more edge nodes of the optical burst-switched network.

1     5.     The apparatus of claim 1, wherein the optical burst-switched network comprises a  
2     photonic burst switched (PBS) network.

1     6.     The apparatus of claim 5, wherein the optical burst-switched network comprises a  
2     wavelength-division multiplexed (WDM) PBS network; and the optical switching fabric  
3     provides switching of optical signals comprising different wavelengths carried over common  
4     fibers that may be respectively coupled to said at least one input fiber port and said at least  
5     one output fiber port.

1     7.     The apparatus of claim 5, wherein the resource reservation request is sent via a PBS  
2     control burst, and the resource cancellation message is included as part of a resource  
3     cancellation control burst having a format similar to the PBS control burst.

1 8. The apparatus of claim 1, wherein reserving the bandwidth resource comprises  
2 storing resource reservation data in a resource reservation table.

1 9. The apparatus of claim 1, wherein detecting an unavailability of the reserved resource  
2 comprises detecting a traffic contention that limits access to the reserved resource.

1 10. The apparatus of claim 1, wherein detecting an unavailability of the reserved resource  
2 comprises detecting one of a failure of the switching node apparatus or failure of one of the  
3 incoming and outgoing fiber links.

1 11. The apparatus of claim 1, wherein the resource cancellation message is sent to a  
2 network node that is downstream from the switching node apparatus.

1 12. The apparatus of claim 1, wherein the resource cancellation message is sent to a  
2 network node that is upstream from the switching node apparatus.

1 13. A method, comprising:  
2 reserving, via corresponding resource reservations, network resources at  
3 respective network nodes of an optical-switched network, said network nodes are  
4 coupled via lightpath segments comprising a lightpath for which the network  
5 resources are reserved;  
6 detecting an unavailability of a network resource along the lightpath;

7                   generating a resource cancellation message identifying network resources that  
8                   may be released;  
9                   sending the resource cancellation message to at least one network node along  
10                  the lightpath; and  
11                  canceling any resource reservations identified by the resource cancellation  
12                  message for said at least one network node.

1   14.    The method of claim 13, where the optical-switched network is a mesh-architecture  
2   optical network.

1   15.    The method of claim 13, where one or more edge nodes are directly connected to at  
2   least one switching node of the optical-switched network.

1   16.    The method of claim 13, wherein the optical-switched network comprises a photonic  
2   burst-switched (PBS) network.

1   17.    The method of claim 16, wherein the optical-switched network comprises a  
2   wavelength-division multiplexed (WDM) PBS network.

1   18.    The method of claim 16, wherein the resource reservation request is sent via a PBS  
2   control burst, and the resource cancellation message is included as part of a resource  
3   cancellation control burst having a format similar to the PBS control burst.

1 19. The method of claim 16, wherein each node is responsible for managing its own  
2 resource cancellation messages and releasing its resources.

1 20. The method of claim 16, wherein the unavailability of the network resource is  
2 detected at a given network node, and the resource cancellation message is sent to all  
3 network nodes that are upstream along the lightpath from said given network node.

1 21. The method of claim 16, wherein the unavailability of the network resource is  
2 detected at a given network node, and the resource cancellation message is sent to all  
3 network nodes that are downstream along the lightpath from said given network node.

1 22. The method of claim 16, wherein the unavailability of the network resource is  
2 detected at a given network node, and the resource cancellation message is sent to all other  
3 network nodes that are along the lightpath.

1 23. The method of claim 16, wherein the resource cancellation message is generated at a  
2 given network node for which wherein the unavailability of the network resource is detected.

1 24. The method of claim 16, wherein reserving the network resource comprises storing  
2 resource reservation data in a resource reservation table, and wherein canceling the resource  
3 reservation comprises one of deleting or invalidating a record in the resource reservation  
4 table corresponding to the resource reservation.

1 25. The method of claim 16, wherein detecting an unavailability of the reserved network  
2 resource comprises detecting a traffic contention that limits access to the reserved resource.

1 26. The method of claim 16, wherein detecting an unavailability of the reserved network  
2 resource comprises detecting one of a failure of the switching node apparatus or failure of  
3 one of the incoming and outgoing fiber links.

1 27. The method of claim 16, wherein the resource cancellation message contains data  
2 identifying a type of resource unavailability that is detected.

1 28. The method of claim 16, wherein the resource cancellation message contains data  
2 identifying the node at which the resource unavailability was detected.

1 29. The method of claim 16, wherein the resource cancellation message contains data  
2 identifying at least one label corresponding to one or more resource reservations that are to  
3 be cancelled.

1 30. The method of claim 16, wherein the resource cancellation message contains data  
2 identifying a lightpath for which resource reservations are to be cancelled.

1 31. The method of claim 30, wherein the data identifying the lightpath for which resource  
2 reservations are to be cancelled comprises a burst identifier (ID) that matches a control burst  
3 ID corresponding to a control burst that was employed to make the resource reservations.

1 32. A machine-readable medium to provide instructions, which when executed by a  
2 processor in a switching node apparatus comprising a network node in an optical switched  
3 network, cause the switching node apparatus to perform operations comprising:

4 receiving a resource reservation request to reserve a bandwidth resource  
5 provided by the switching node apparatus, said resource reservation relating to a  
6 portion of a lightpath comprising a plurality of lightpath segments coupled between  
7 network nodes in the optical switched network, including incoming and outgoing  
8 lightpath segments coupled to the switching node apparatus;

9 reserving the network resource;

10 detecting an unavailability of the network resource;

11 generating a resource cancellation message; and

12 sending the resource cancellation message to at least one network node along  
13 the lightpath.

1 33. The machine-readable medium of claim 32 wherein execution of the instructions  
2 further performs the operations of:

3 canceling a resource reservation in response to receiving a resource cancellation  
4 message.

1 34. The machine-readable medium of claim 32, wherein the optical burst-switched  
2 network comprises a photonic burst switched (PBS) network.

1 35. The machine-readable medium of claim 34, wherein the optical burst switching  
 2 network comprises a wavelength-division multiplexed (WDM) PBS network; and the optical  
 3 switching fabric provides switching of optical signals comprising different wavelengths  
 4 carried over common fibers that may be respectively coupled to said at least one input fiber  
 5 port and said at least one output fiber port.

1 36. The machine-readable medium of claim 34, wherein the resource reservation request  
 2 is sent via a PBS control burst, and the resource cancellation message is included as part of a  
 3 resource cancellation control burst having a format similar to the PBS control burst.

1 37. The machine-readable medium of claim 32, wherein reserving the bandwidth  
 2 resource comprises storing resource reservation data in a resource reservation table.

1 38. The machine-readable medium of claim 32, wherein detecting an unavailability of the  
 2 reserved resource comprises detecting a traffic constraint that limits access to the reserved  
 3 resource.

1 39. The machine-readable medium of claim 32, wherein detecting an unavailability of the  
 2 reserved resource comprises detecting one of a failure of the switching node apparatus or  
 3 failure of one of the incoming and outgoing fiber links.

1 40. The machine-readable medium of claim 32, wherein the resource cancellation  
 2 message is sent to a network node that is downstream from the switching node apparatus.

- 1 41. The machine-readable medium of claim 32, wherein the resource cancellation
- 2 message is sent to a network node that is upstream from the switching node apparatus.